

# Perceptions of Private Forest Owners in West Virginia on the Use of Prescribed Fire in Forestry

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**Abstract** *Prescribed fire* is the controlled application of fire to accomplish planned land management objectives. Public acceptance of prescribed fire varies in different parts of the world, and is little known in the state of West Virginia, USA. West Virginia is about 80% forested, and most of the forest land is in private ownership. Further, the region is home to oak (*Quercus* spp.), a possibly fire-dependent and highly valuable genus. Due to real and perceived risks associated with prescribed fires, it was hypothesized that forest owners are unwilling to accept the use of prescribed fire as a forest management option, even for the regeneration of oak. Non-industrial private forest owners in West Virginia were surveyed to shed light on their attitudes and opinions regarding the use of prescribed fire as a forest management tool. Contrary to the hypothesis, 64% of the responding owners were supportive of the use of prescribed fire. Acceptance was related to knowledge of prescribed fires or of firefighters. Major concerns included personal and property safety and being informed prior to burning. Therefore, while acceptance of prescribed fires among forest owners is high, timely notification can ensure further and, likely, increased, cooperation from the landowners.

**Keywords** Private landowners · Attitudes · Forest management · Oak regeneration

## Introduction

Fire has shaped most of the vegetation around the world, including large parts of Eurasia, the Mediterranean region, Australia, the North American Continent, and

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parts of Africa. Additionally, the history of land use in the world included fire as an important tool in forestry, agriculture and pastoralism; this tool created landscape patterns of high ecological and cultural diversity. Heathlands, open grasslands, meadows, shifting agriculture and even the boreal forests are all known to have been maintained with burning (Goldammer et al. 2008). However, expanding urban development, air quality concerns and standards, and viewing fire as a general menace have led to intense efforts in fire suppression and to reduction in traditional burning practices around the world. Among the most well-known campaigns to suppress—and ideally eliminate—fire from forest ecosystems was that of ‘Smokey Bear’ in the USA. Other efforts were equally successful in Europe, where complete bans on using fire have been instituted for example in Germany and Hungary (Goldammer et al. 2008).

The Appalachian hardwood forest, extending in the eastern part of the USA from the state of Maine to Georgia, has been maintained by fire (Brose et al. 2001; Lorimer 2001; Nowacki and Abrams 2008). The Appalachian forest is unique in its high biodiversity, which is second only to tropical forests (Hicks 1998). Intense fire suppression in the early 1900s resulted in a shift in forest composition from fire-dependent oak, pine and chestnut to fire-sensitive maples, cherry, beech and hemlock (Stephens and Ruth 2005; Nowacki and Abrams 2008). Evidence suggests that the successful regeneration of several species in the Appalachian forest relies on fire to control competing vegetation. Notable among these are oaks (*Quercus* spp.), which are among some of the most economically and ecologically valuable species (Brose et al. 2001; Shumway et al. 2001; Signell et al. 2005). Oak abundance is declining (Nowacki and Abrams 2008), and prescribed fire is increasingly used to facilitate oak regeneration (Brose et al. 2008).

Another consequence of intense fire suppression has been an increase in catastrophic fires resulting from the accumulation of woody fuels (Pastor et al. 2006; Goldammer et al. 2008). Between 1960 and 2003, wildfires in the USA consumed on average 1.64 M ha annually. Between 1999 and 2003, that average increased to 2.27 M ha per year. The cost of fire suppression in the USA in 2002 reached 1.6 billion US dollars (NIFC 2004). By comparison, less than 50,000 ha burned annually in Spain between 1960 and 1970, increasing between 1999 and 2003 to approximately 400,000 ha annually (Rego et al. 2009). The increase in catastrophic fires led to a paradigm shift in ecology and nature conservation, increasing an interest in programs that reintroduce fires into fire-adapted ecosystems around the globe (Goldammer et al. 2008).

Prescribed fire is the controlled application of fire to existing natural fuels under specified environmental conditions and appropriate precautionary measures, which allows the fire to be confined to a predetermined area and accomplishes planned land management objectives. Among most common forest management objectives that are accomplished with prescribed fire are fuel reduction, site preparation for tree planting, disease control, enhancing or creating wildlife habitat, range maintenance, and biological community restoration and maintenance (Florida Dept. of Forestry 2009).

Prescribed fire can mimic disturbance events and maintain open and diverse habitats and landscapes. There are now experimental prescribed burning projects in

many of the Eurasian countries (Goldammer et al. 2008). Experiments with using fire in the northern region of Spain commenced about 10 years ago (Pastor et al. 2006), and small-scale experiments in Hungary were first conducted in 2005 (Goldammer et al. 2008). Current fire management practices in fire-prone ecosystems around the world focus on the prevention of wildfire; secondary goals may be to maintain or increase biodiversity. Sometimes these goals may not be complementary. In south-eastern Australia, periodic low-intensity prescribed fires reduce the amount of flammable fuels and the risk of catastrophic fires; however, these low intensity fires are insufficient to maintain biodiversity in fire-dependent shrub ecosystems (Morrison et al. 1996).

The use of prescribed fire as a management tool brings together biological and social sciences. Recent experiments with using prescribed fire in western Europe were rooted in extensive consultation with stakeholders (Goldammer et al. 2008). An increase in fire-related education, whether at universities as in Spain and Germany, forest manager levels as in Sweden, or political levels as in Hungary, suggests an increased political and public acceptance (Pastor et al. 2006; Goldammer et al. 2008). However, in many parts of the world, notably in Europe and in parts of Asia, reintroduction of fire into the forest management toolbox is so new that citizens' perceptions have not yet been assessed (Goldammer et al. 2008).

Prescribed fire is generally accepted in the USA as a legitimate forest management practice, especially among the more educated or informed citizens (Cortner et al. 1984; Manfredo et al. 1990; Shindler and Toman 2003; McCaffrey 2006; Blanchard and Ryan 2007). Proximity to a national forest where prescribed fire might be used was not a strong indicator of support (Vining and Merrick 2008); rather, control of prescribed burns and trust in fire authorities were the chief issues associated with acceptance of prescribed fire (McCaffrey 2006). However, the acceptance is context-specific and the fallibility of forest managers is apparent to people who have experienced escaped prescribed fire (Brunson and Evans 2005). In Michigan, the Mack Lake fire—a prescribed fire that escaped control lines, caused substantial property damage and took the life of one firefighter—led local citizens to claim prescribed fire is a 'reckless strategy given past failures' (Winter and Fried 2000). Survey respondents in Florida felt that the risk of escaped prescribed fire was high (Jacobsen et al. 2001). Communication and contact between local government and private citizens increased acceptance of using prescribed fire (McCaffrey 2004).

Opinions of local populations on the use of prescribed fire are little known in the Appalachian Mountains. In West Virginia in particular, mostly private ownership of relatively small parcels of forest land (averaging about 10 ha according to Joshi and Arano 2009) may deter the use of prescribed fire as a forest management tool. At the same time, high forest cover at almost 80% of land area may necessitate more frequent use of intensive forest management tools, including prescribed fire, to accomplish forest health objectives. Therefore, an increased understanding of landowners' attitudes toward and their willingness to use prescribed fire is important to the integrity of the Appalachian forest.

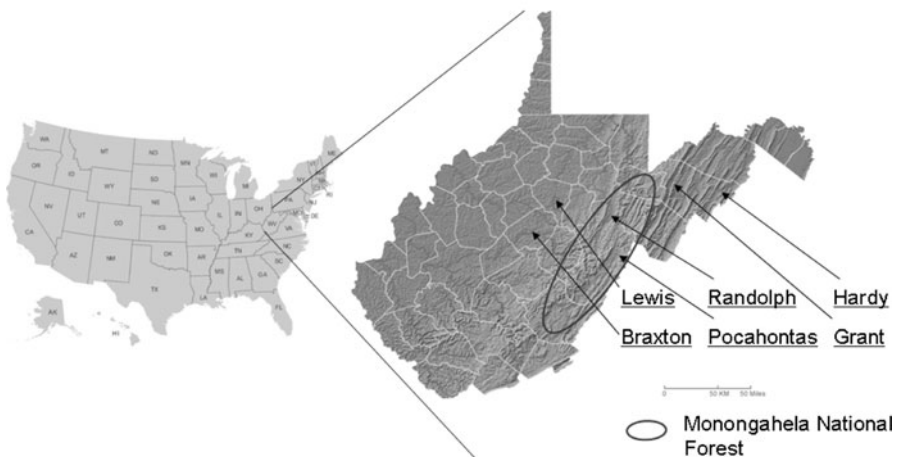
The research reported here was designed to provide a general understanding of whether forest owners in West Virginia (1) approve of the use of prescribed fire as a

forest management tool, (2) approve of the use of prescribed fire specifically to promote oak regeneration, (3) are likely to use prescribed burning on their own properties, and (4) accept the use of fire on public land. It was hypothesized that forest owners are unwilling to accept and use prescribed fire, even for the regeneration of oak, due to inherent risks associated with prescribed fires.

## Research Method

A mail survey was conducted in three regions of West Virginia to investigate prevailing opinions among landowners on the use of prescribed fire to accomplish forest management objectives on their own and on public land. Three regions in West Virginia were selected based on the proximity to the Monongahela National Forest (MNF) (Fig. 1), where prescribed burning is increasingly used as a management tool. Two adjacent counties were selected in each of these regions. A western region included Braxton and Lewis counties, a central region included Randolph and Pocahontas counties, and an eastern region included Grant and Hardy counties. The reason for selecting these regions was that prevailing wind direction from west to east creates a potential gradient of smoke pollution from prescribed fire activities on the MNF. It was hypothesized that landowners' location in relation to possible smoke effects might influence how they view prescribed fire.

One hundred forest owners were randomly selected in each of the three regions (300 in total). These individuals were the listed property owners of at least 20.2 ha in a database purchased from the West Virginia Tax Office in spring 2005. This minimum property size was selected to pare down the original list of 51,638 property owners in the sampling area. Property size was used to ensure the respective forest owners had adequate area to conduct at least one commercial



**Fig. 1** General location of West Virginia within the USA (left), and location of counties within West Virginia (right), where the study was conducted. *Note.* The area within the oval represents the extent of the Monongahela National Forest, where use of prescribed fire is likely

timber harvest; the assumption was that this potential for a timber sale suggests a relatively high level of interest in engaging in forest management at some time, whether currently or in the future. In contrast, smaller properties were assumed to have smaller manageable area, especially properties that served as a primary residence. An earlier study surveyed forest owners throughout West Virginia who had sold timber in 2001–2002 and found respondents' median timber harvesting area to be 16 ha (McGill et al. 2004). The lower cutoff area of 20.2 ha for selecting properties to sample was chosen to conform with the major descriptive category breakpoint of 20.2 ha for the USA nationwide forestland owner surveys (reported by Birch and Kingsley 1978; Birch 1996a, b).

A questionnaire was developed to assess attitudes and preferences of private forest owners toward the use of prescribed fire. For example, to assess general attitudes, the question was posed: 'Do you approve or disapprove of using prescribed fire in forests? Why? (check only one)', where possible responses were: 'approve, main reason', 'disapprove, main reason', 'no opinion'. Because it is not necessary to *approve* of the use of prescribed fire to understand benefits for forest-related outcomes, a different question specifically probed perceived benefits of prescribed burning. Questions addressing general preferences related to the type of land where prescribed fire should be permitted—on non-industrial private, public-federal, public-state, other public (e.g. National Park Service), or forest industry. Included in this survey were additional questions relating to the experiences of fire in general, and to demographic attributes.

Draft questionnaires were sent to four natural resource professionals involved in resource management, fire control and fire ecology to obtain comments on question clarity and accuracy of terminology, and suggestions on additional questions of importance to their own needs. Their comments and editorial suggestions were incorporated into the final questionnaire.

Questionnaires were sent to each of the randomly-selected forest owners using a four phase method proposed by Dillman (2000), i.e. a pre-questionnaire postcard, questionnaire, reminder postcard, and second questionnaire. The initial pre-questionnaire notification postcard was sent to forest owners in May 2009. Other mailing followed at approximately two-week intervals.

Tests for differences in opinions and attitudes among regions were conducted using a single-factor analysis of variance for responses recorded as ordinal variables (using Likert-scales). The single independent factor 'region' consisted of the regions described above. Logistic regression was used to make comparisons among regions for binary (yes/no) responses. Odds ratios (OR) were used as a quantitative measure of strength of association between respondent locations and demographics and measures of their opinions and attitudes related to prescribed fire. All statistical procedures were carried out using SAS version 9.1. The significance level was set at  $\alpha = 0.10$ .

## Results

Survey addressees returned 131 questionnaires of the total 300 that were initially mailed, of which 2 were not eligible duplicates. Responses included 93 completed

and 14 partially completed questionnaires. Complete and partial survey responses represented a 36% response rate. The contact rate was calculated as  $(131 + 5 \text{ deceased}) / (300 - 2 \text{ duplicates}) = 46\%$ . The cooperation rate or the percent of all those contacted that completed or partially completed the questionnaire was 82%; the refusal rate was 18%.

The average age of the responding forest owners was 67 years, with modal annual income in the range of USD \$45,001 to \$60,000. About 24% of the respondents had completed high school, and 29% more attended college, 23% receiving a graduate degree (Table 1). Males made up the majority of the respondents (71%). Secondary education among females was higher (74%) than males (67%), although there were seven male respondents with a doctoral degree.

Forest owners spent on average 5.8 h per week exposed to media, the most popular being television (2.2 h), radio (1.2 h), internet (1.0 h) and newspaper (0.8 h). The least popular media were magazines (0.6 h) and videos (less than 0.1 h) per week.

Many of the respondents had experienced some direct exposure to wildfires. About 45% indicated that they had experienced a fire on their properties; these included structure fires (49%), field or pasture fires (21%), and forest fires (45%). Furthermore, 57% had direct contact with firefighters including close friends (57%), neighbours (36%), family members (28%) and acquaintances (7%).

### Forest Owners Attitudes Toward Prescribed Burning

Polled forest owners indicated that they had at least a medium level of (general) knowledge of prescribed fires (average score of 2.4 on a scale of 1 for low, to 3 for high). In their view, the level of risk for property loss from wildfires was low (2.2 on a scale of 1 for very low, 2 for low, 3 for medium, and 4 for high) while that from prescribed fire was moderate (3.2).

Almost half of the forest owners (49%) approved of the use of prescribed fire, 19% disapproved, and 26% had no opinion (Table 2). Clearing the forest floor (23%) and forest growth (18%) were among the most important reasons for approving of the use of prescribed fire (Table 2). The 'other' reasons for approval included 'lower risk of loss', 'better tree growth and better grazing land', 'cut down on source of fuel', 'regeneration and clean forest floor', 'necessary to prevent major

**Table 1** Education of forest owners in West Virginia responding to the survey

Education level	Relative frequency (%)
High school	24
Technical/trade school	5
Associate degree (2-year college)	5
Some college	14
Bachelor's degree	15
Master's degree	17
Doctorate degree	6
No information	14

**Table 2** General attitudes of West Virginia forest owners toward prescribed fires in general, and associated factors

Attitudes toward prescribed fire (PF)	Percentage of respondents
Attitude toward prescribed fire	
Approve	49
Disapprove	19
Reasons for approval	
Clearing the forest floor	23
Forest growth	18
Appropriate/effective tool	12
Prevents wildfire	5
Beneficial to wildlife	5
Fire is natural	5
Other <sup>a</sup>	22
Where should PF be conducted?	
Public forests (in WV)	65
Forest industry land	68
Private (non-industrial) forest	55
Willingness to tolerate smoke or the sight of smoke	
1–2 times/year	54
3–4 times/year	15
5 or more time/year	5
Not at all	26
Perceived benefits of PF	
Regeneration	20
Preventing wildfires	19
Control brush	12
Multiple benefits	12
Other	13
No benefits	16

<sup>a</sup> This category is treated in text above

fire', 'insect control', 'natural forest needs prescribed fire', 'timber and fire management', and 'with too many leaves, water can't get to the ground'.

Reasons for disapproval of prescribed fire were: 'dangerous', 'not necessary', and (other) 'nature takes care of itself', 'danger to standing timber', 'loss of timber value and creates air pollution', 'kills too much vegetation', 'may become unmanageable', 'tends to get out of control in southern West Virginia', 'leaves and dead wood finally become composted thus enriching the forest floor', 'kills young growth', 'loss of animal and wildlife habitat', and 'risk of fire without it is low'.

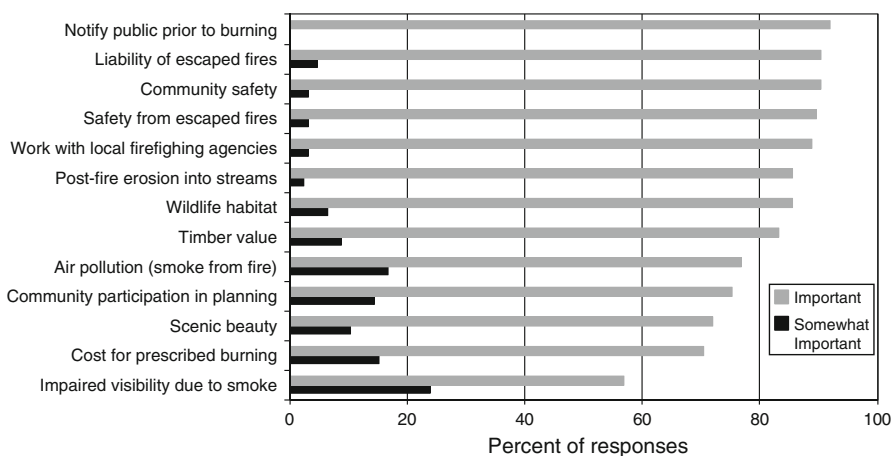
Forest owners were somewhat more inclined to accept the use of prescribed burning in public and forest industry forests in WV than in private forests (Table 2). Also, the majority of the respondents (74%) would be willing to tolerate the smell and the sight of burning (Table 2). However, when asked whether it is likely that

they will be affected by smoke if more prescribed burning were used on the Monongahela National Forest, 53% of respondents answered 'not likely', while 15% said 'very likely', and 15% said 'somewhat likely' (indicating proximity to the forest).

In addition to the reasons for general approval or disapproval, respondents were also asked about perceived benefits of prescribed fire. In the view of the polled forest owners, the most widely perceived benefits of using prescribed fires were forest regeneration (reported by 20% of respondents) and preventing wildfires (19%) (Table 2).

Forest owners had many concerns related to the use of prescribed burning as a management tool. Most (61%) expressed lack of control as the biggest concern about using prescribed fires. Among 'important' concerns, the highest response rates (of 89% or more) were about being notified prior to burning, liability issues of escaped fires, community safety, general safety particularly from escaped fires, and coordinating prescribed fire activity with local fire-fighting agencies (Fig. 2). Post-fire soil erosion into streams, damage to wildlife habitat and loss of timber value received slightly more than 80% of responses. Community participation in planning, smoke-related issues, costs of prescribed burning and loss of scenic beauty were important in fewer responses (Fig. 2). Among 'not important', impaired visibility due to smoke (11%), followed by air pollution from smoke and loss of scenic beauty (6% each), and costs of prescribed burning at 4%, received highest percentages of responses. The average non-response rate for this question was 7%.

When asked about their personal opinions on the use of prescribed fire, with possible responses of 'very supportive', 'somewhat supportive', 'somewhat against', 'against', and 'no opinion', 64% of forest owners were either 'somewhat supportive' or 'very supportive' of the use of prescribed burning in forests. One out of four was at least somewhat against the use of prescribed fire while others did not respond to the question.



**Fig. 2** Percent of questionnaire respondents associated with each concern about using prescribed fires. Not important' received on average 3% of responses



When asked about alternative approaches to regenerating oak seedlings which compete poorly with heavy competition from other species, 34% of responding forest owners said that the best approach would be prescribed burning, 29% said that mechanical approach (using chainsaws, bulldozers, or 'weed eaters' to eliminate competition) for a combined 63% approval for activities to promote oak regeneration. Twenty-two percent said 'do nothing' would be best. Only 2.3% of respondents indicated that using herbicide would be the best approach. The highest percentage of opinions on the 'worst' approach went to herbicide use at 32.8% of responses, followed by 'do nothing' at 22.4%; both of the mechanical and prescribed burning approaches were classed as 'worst' in 9.6% of the responses.

### Comparison of Opinions on Prescribed Fire among Regions

Some of the opinions related to the use of prescribed fire differed among regions of West Virginia. Respondents in the central region were more supportive of using prescribed burning than those in the west. On a scale of 'very supportive' (4), 'somewhat supportive' (3), 'somewhat against' (2), and 'against' (1), the respondents of the central region averaged 3.12 compared with 2.70 in the eastern region and 2.44 in the western region. Eastern region support scores were statistically greater than those of the western region ( $P = 0.020$ ).

For the most part, concerns related to prescribed burning were consistent among regions. However, safety from escaped fires and importance of working with local firefighting agencies were of greater importance to forest owners in the eastern than the western region ( $P = 0.067$  and  $P = 0.028$ , respectively). In the case of willingness to accept prescribed burning on public or private properties, forest owners in the western region were 4.3 times as likely to consider that prescribed burning should not be carried out on public land, relative to those in the east ( $P = 0.036$ ).

### Factors Associated with Approval of Prescribed Burning

About 49% of survey respondent generally approved of prescribed burning. Those that approved were more likely to know a firefighter or possess some knowledge about prescribed fires (Table 3). Thus, those that had seen a forest fire had twice the odds (odds ratio = 2.14), or were 20% more likely to approve than to disapprove of prescribed fire; those that had not seen a forest fire were only half as likely to approve of using prescribed fire.

## Discussion

### Attitudes of Polled Landowners Toward Prescribed Fire

West Virginia landowners appear to be quite accepting of the use of prescribed fire in forest management. Asked at the outset of the questionnaire whether they generally approved or disapproved of prescribed fire, the respondents' approval was

**Table 3** Variables associated with approval of prescribed fire in West Virginia

Independent variable <sup>a</sup>	OR <sup>b</sup>	90% CI <sup>c</sup>	$P > \chi^2$ <sup>d</sup>
Total media time	0.98	0.91–1.05	0.569
Newspaper-reading	1.03	0.65–1.63	0.91
Internet	0.91	0.74–1.13	0.479
Television-viewing	1.02	0.84–1.24	0.876
Radio-listening	0.97	0.84–1.13	0.769
Magazines—reading/browsing	0.96	0.83–1.10	0.591
Know a firefighter <sup>e</sup>	3.49	1.73–7.01	0.003
Knowledge level (about prescribed fire) <sup>f</sup>	2.26	1.22–4.17	0.029
Affected by smoke <sup>g</sup>	0.49	0.23–1.02	0.110
Gender	0.69	0.38–1.27	0.317
Have seen a forest fire	2.14	1.06–4.32	0.077
Experienced fire on property	0.70	0.32–1.54	0.368

<sup>a</sup> Logistic regression using binary dependent variable ‘approve of the use of prescribed fire in forests’

<sup>b</sup> Odds ratio (OR)

<sup>c</sup> 90% confidence interval of the odds ratio point estimate

<sup>d</sup> Probability value for the Wald  $\chi^2$  test

<sup>e</sup> This question asked: ‘Do you know or are you related to any firefighters? Yes/No’

<sup>f</sup> This question asked: ‘Please rate your level of knowledge about prescribed fires (check only one)—high (1), medium (2), low (3)’

<sup>g</sup> This question asked: ‘If prescribed burning is used more and more on the northern MNF, how likely it is that you would be affected by smoke?—very likely (1), somewhat likely (2), not likely (3), don’t know (4)’

lower (49%; Table 2) than when asked again about ‘support for prescribed fire’ at the end of the questionnaire (64% support). The reasons for the different responses are likely two-fold. First, one does not have to approve of the use of prescribed fire to understand that there are benefits to using it in forests. Therefore, some of those respondents who have not approved were able to list a benefit. Second, the question about ‘support’ followed several other questions which listed positive (and negative) aspects of prescribed burning; having had an opportunity to consider some of the issues associated with prescribed fire may have affected the response. Enhancing forest growth, presumably via eliminating competing growth, was one of the reasons (18% of responses) for the high approval (early question). Among benefits of prescribed fire (question toward the end of the questionnaire), however, preventing wildfires was listed most frequently.

The majority of respondents preferred using management activities to promote oak regeneration over doing nothing; prescribed fire received a somewhat higher approval rate than mechanical means. Approval of two different means for promoting oak regeneration may indicate a misalignment between the current state of professional knowledge and landowners’ attitudes; namely, landowners may be driven by a different set of ideas or values in their decisions regarding activities they feel should be used than professionals. This may simply indicate a delay in

technology transfer, specifically in disseminating recent knowledge about effects of prescribed burning on oak regeneration. Nevertheless, the combined results of forest owners' acceptance of prescribed fire, of preferred activities to regenerate oak, and of prescribed fire for oak regeneration, show that forest managers in West Virginia have a responsive landowner base that might support prescribed fire specifically for oak regeneration.

A high level of acceptance of prescribed burning is consistent with trends found elsewhere in the USA, especially among the more educated citizens (Cortner et al. 1984; Manfredo et al. 1990; Shindler and Toman 2003; McCaffrey 2006; Blanchard and Ryan 2007). Widespread acceptance of prescribed burning is also prevalent in Australia, where it has been so effective in reducing the wildfire threat in some parts, that local inhabitants have developed a false sense of security (Cheney 1996), and catastrophic fires are blamed on insufficient levels of prescribed burning (Pyne 1991). However, the situation is different in other parts of the world. For example, awareness of the role of fire as an important ecological factor has increased dramatically among foresters and the public in Sweden; this has led to the incorporation by the Swedish Forestry Stewardship Council (FSC) of regulations that require 5% of felled areas to be burnt. Still, this level of burning has not been achieved in Sweden due largely to a lack of experienced personnel, concerns over the risk of escaped fires, and a lack of resources (Goldammer et al. 2008).

Findings in other regions of the USA and elsewhere (McCaffrey 2006; Pastor et al. 2006) indicate that people consider aesthetic issues associated with burning among the most important. However, loss of beauty in burning may not automatically translate into avoidance of burned areas; residents in southeastern Australia, for example, viewed areas that had not been recently burned in a prescribed fire as more appealing than those that had burned, but they continued visiting the areas that had burned, and were not even deterred by smoke from nearby continuing burning activities (Bell and Oliveras 2006). The polled West Virginia forest owners were less concerned about the inconvenience associated with smelling smoke, decreased visibility, or even loss of scenery. This was unexpected, and may result from lack of prior exposure to these inconveniences. Alternatively, with an almost complete forest cover in the polled counties, a temporal loss of aesthetic value may not seem to be an issue for landowners, especially because catastrophic fires are rare in the state.

### Landowners' Concerns About Using Prescribed Fire

About 61% of the West Virginia forest owners surveyed indicated that lack of control was their biggest concern associated with the use of prescribed burning. In fact, it was somewhat surprising that forest owners would deem risk from wildfires as less than that from prescribed burning. This may be associated with a low probability that a forest wildfire would burn near someone's home. Fire-return interval for the northern US hardwood forest (which includes a portion of the Appalachians) is between 200 and 400 years (Leenhouts 1998). However, once planned and executed, a prescribed fire occurs with certainty, carrying with it a potential for escaped fire to which landowners may be sensitive.

This trend of sensing great risk has been described elsewhere, and is particularly acute in areas that have experienced damage to property and loss of human life from escaped prescribed fire activities (Winter and Fried 2000; Jacobsen et al. 2001; Brunson and Evans 2005). In contrast, Australian residents seem to feel safer with—and prefer to have—more areas treated with prescribed fire than not (Bell and Oliveras 2006); this trend is clearly associated with high danger from wildfires (bushfires), which are probably not perceived as likely in West Virginia. Security is also high on the list of concerns for the inhabitants of the Eurasian region, as is the health impact of inhaling smoke from forest fires (literature cited in Goldammer et al. 2008).

Other concerns that currently limit the expansion of prescribed fire activities in other parts of the world include site degradation and depletion of terrestrial carbon stocks. These factors are particularly relevant in the political context of climate-change, while vulnerability of organic soils and peatlands is a major concern in northern Europe (Goldammer et al. 2008). The threats of unexploded ordnance including land mines on former military exercise and combat areas, and contamination of forests and other ecosystems by radionuclides from nuclear accidents or nuclear weapons tests during the Cold War, constitute further limitations in the use of prescribed fire in Eurasia (literature cited in Goldammer et al. 2008).

### Importance of Communication to Acceptance of Prescribed Fire

An overwhelming number of private forest owners in West Virginia viewed public notification among the most important concerns related to the use of prescribed fire as a management tool. These results indicate that an increased level of communication between forest managers and the public, especially providing information about safety precautions, may further increase the number of forest owners willing to support prescribed burning. This reveals that communication is important for increasing public acceptance of the use of prescribed fire as a management tool, and local forest management needs to work with the public during the planning stages. This reflects findings elsewhere in the USA (McCaffrey 2004) and Europe (Goldammer et al. 2008). Part of the communication effort should include education; as was found elsewhere, prescribed burning is much more accepted among the knowledgeable than non-informed citizens (Cortner et al. 1984; Manfredo et al. 1990; Shindler and Toman 2003; McCaffrey 2006; Blanchard and Ryan 2007).

Media are largely responsible for how the public views fire; because wildfire has been portrayed in the media as a dramatic event, wildfire has attracted criticism. Therefore, establishing regular contact with the media may help to eliminate unnecessary misconceptions and misunderstandings of fire management (Apsey 1988).

Choice of media for communicating of management activities that include prescribed burning will be an important consideration. The polled forest owners preferred television over internet or newspapers; therefore, TV stations should be a medium of choice for providing timely information. Radio and newspaper seem the

other most applicable media for forest owners in WV to find out about public announcements. However, as younger generations start inheriting or owning more of the private forests, the choice of media is likely to shift from television to web-based or cellular technology. Finally, with access to direct marketing services, it is not unrealistic to employ direct mailings in rural areas to alert not only community leaders, but a large segment of the population of impending prescribed fires.

## Conclusions

Most of West Virginia forest owners accept the use of prescribed burning in forest management, want to be notified of potential prescribed-burning activity, and support efforts to regenerate oak. Concerns for the safety of property and human lives are high and must be taken into account by forest management agencies. Therefore, with proper notification, forest managers planning to use prescribed fire are likely to encounter landowner cooperation. The polled West Virginia landowners were less concerned about smoke or loss of aesthetic value—values held in very high regard elsewhere in the USA and the world. It may be worth exploring whether lack of exposure to wildfire may help explain that. These attitudes may be different in the southern part of the state, where wildfires are much more common due to incendiary activity.

Nothing is known about the attitudes of non-forest owners in West Virginia toward prescribed burning, so this warrants an investigation. Non-forest owners typically reside in urban areas, are more likely to be already affected by urban pollution, and may be less aware than landowners of silvicultural practices, economic or ecological values of tree species, or current challenges to forest ecosystem structure and function. On the other hand, urban dwellers may be more politically engaged, have better access to political representatives and media outlets, and may stand a better chance to influence public policy than landowners. In an effort to elevate prescribed burning to general acceptance, knowledge of attitudes of non-forest owners will be necessary.

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